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I CLAIM:

1. A window sash balance system having a pair of sash shoes running vertically within jamb shoe channels with a sash that runs vertically in jamb sash runs separate from the shoe channels, the sash shoes being biased upward by the force of curl springs, and connections between the shoes and the sash transmitting the upward bias force from the shoe channels to the sash in the sash runs, the balance system comprising:

- P1
- a. free end regions of the curl springs being fastened in the shoe channels in regions above the vertical travel of the shoes, and uncurled lengths of the curl springs being laid against walls of the shoe channels above the shoes without sliding frictionally up and down against the shoe channel walls when the shoes move;
 - b. the uncurled lengths of the curl springs passing through openings in the shoes to containment regions within the shoes where variable lengths of the springs curl up in convolutions; and
 - c. containment of the curled convolutions of the springs within the shoes being arranged for applying the upward bias force to the shoes from a recurling force of the curl springs which is exerted in the shoe containment regions.
- P1
- P1

2. The balance system of claim 1 wherein axes of the curl springs are parallel with the plane of the sash.

3. The balance system of claim 1 wherein the connections that transmit the upward bias of the curl springs allow the sash to tilt.

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4. The balance system of claim 3 wherein the connections are arranged for locking the shoes in the shoe channels when the sash tilts.

5. The balance system of claim 1 wherein the shoes are formed of two identical parts that close together to form the containment regions for the curl springs.

6. The balance system of claim 5 wherein the shoe parts contain pin receivers that are arranged for camming the shoe parts apart to lock the shoes in the shoe channels when the sash tilts.

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B17 ~~7. The balance system of claim 1 wherein each of the shoes has a plurality of the containment regions for receiving a plurality of curl springs.~~

8. A curl spring sash balance system comprising:

- claim 7*
P1
- a. convolutions of a curl spring being carried by a sash shoe so that the spring can uncurl from the shoe and dispose an uncurled length to lie against a wall of a shoe channel in which the shoe moves alongside and spaced from the balanced sash and so that a recurled tendency of the spring occurring where the uncurled length returns to the curled convolutions imparts a lift that the curled convolutions transmit to the shoe; and
 - b. a free end region of the curl spring being secured to the shoe channel above the shoe travel so that the curl spring does not move against the shoe channel surface as the shoe moves up and down in the shoe channel.
- P1*

9. The balance system of claim 8 wherein an axis of the curl spring convolutions is parallel with a plane of the sash.

claims 10-19
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N
10. The balance system of claim 8 wherein the curl spring is disposed so that an outer one of the curled convolutions exerts a lifting force transmitted to the shoe.

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11. The balance system of claim 8 wherein the curled convolutions are carried within the shoe, and an upper region of the shoe is recessed to permit movement along the uncurled length of the curl spring lying against a wall of the shoe channel.

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12. The balance system of claim 8 including a pair of curl springs carried by the shoe for cooperatively lifting the shoe.

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13. The balance system of claim 8 wherein a lock connection extending between the sash and the shoe enables the sash to tilt and locks the shoe in the shoe channel in a region below the convolutions of the curl spring when the sash tilts.

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14. In a window having a sash supported by counterbalanced shoes in shoe channels located within interiors of jambs having exteriors that engage stiles of the sash, the improvement comprising:

- P1
- a. a counterbalanced lift applied to the shoes being provided by the recurrl tendencies of curl springs having curled convolutions carried by the shoes and having free end regions fastened within the shoe channels in regions above the travel of the shoes;
 - b. axes of the curled convolutions being parallel with a plane of the sash; and
 - c. the curl springs being arranged for curling up into the shoe-carried convolutions as the shoes move upward with the sash and for uncurling into the shoe channels as the shoes move downward with the sash so that uncurled
- P1
P1
- 26

lengths of the springs do not slide against shoe channel surfaces as the shoes move.

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~~15.~~ The improvement of claim ²⁶~~14~~ wherein the sash is a tilt sash and is connected to the shoes so that tilting the sash locks the shoes in the shoe channels.

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~~16.~~ The improvement of claim ³⁰~~15~~ wherein pins extending from the sash turn pin receivers in the shoes arranged below the curl springs for locking the shoes in the shoe channels when the sash tilts.

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~~17.~~ The improvement of claim ²⁶~~14~~ wherein each of the shoes carries a pair of the curl springs.

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~~18.~~ The improvement of claim ²⁶~~14~~ wherein the curled convolutions are contained within the shoes, and upper regions of the shoes are recessed in regions where uncurled lengths of the curl springs are disposed between the shoes and the shoe channels.

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~~19.~~ The improvement of claim ²⁶~~14~~ wherein the curled convolutions are contained within the shoes, and outer ones of the curled convolutions within the shoes bear against a downward facing interior shoe surface for transmitting spring lift to the shoes.

Sub a'
~~20.~~ A sash shoe configured for running in a shoe channel of a window jamb to transmit counterbalance lifting force to a sash, the sash shoe comprising:
a. a shoe body containing a curled length of a curl spring and having a passageway for a length of the curl spring to uncurl from the body and extend above the body; and
b. a free end region of the uncurled length of the curl spring being connected to a mount that is releasably retained on an upper region

of the shoe body until the mount is fastened to a mounting surface.

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~~21.~~ The sash shoe of claim ¹⁹~~20~~ wherein the retention of the mount on the body automatically releases when the mount is fastened to the mounting surface.

²¹
~~22.~~ The sash shoe of claim ¹⁹~~20~~ wherein a configuration of the upper region of the shoe body for releasably retaining the mount can alternatively retain a holder of an additional curl spring.

²²
~~23.~~ The sash shoe of claim ²¹~~22~~ wherein an upper region of the holder is configured for releasably retaining the mount.

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~~24.~~ The sash shoe of claim ¹⁹~~20~~ wherein the mount engages a pair of openings in the free end region of the curl spring and engages an undercut projection at the upper region of the shoe.

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~~25.~~ The sash shoe of claim ¹⁹~~20~~ wherein the shoe body includes a sash pin receiver that is accessible from either of a pair of opposite sides of the shoe body so that the mounting orientation of the shoe body is reversible.

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~~26.~~ The sash shoe of claim ²⁴~~25~~ wherein the retention of the mount on the body automatically releases when the mount is fastened to the mounting surface in either reversible orientation of the shoe body.

^{Sub 2}
~~27.~~ A sash shoe for engaging a sash and moving with the sash so that the shoe transmits to the sash an upwardly biased counterbalance lifting force, the sash shoe comprising:
a. the shoe being arranged for holding a sash connection and curled convolutions of a curl spring arranged so that an uncurled length of

the curl spring can extend upward from the shoe;

- b. a companion carrier containing a companion curl spring arranged so that an uncurled length of the companion curl spring can extend upward from the companion carrier; and
- c. the curl spring and the companion curl spring being connected together above the companion carrier so that the curling tendencies of the springs tending to curl up any uncurled lengths of the springs are combined to provide the lifting force for the shoe.

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~~28.~~ The sash shoe of claim ~~27~~¹⁴ including a mount connected to free end regions of the springs and releasably retained on an upper region of the companion carrier.

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~~29.~~ The sash shoe of claim ~~27~~¹⁴ wherein the sash connection includes a sash pin receiver arranged below the curl spring.

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~~30.~~ The sash shoe of claim ~~27~~¹⁴ wherein the curled convolutions are contained within the shoes, and a region of the shoe below the curl spring is wider than a region of the shoe adjacent an uncurled length of the curl spring.

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~~31.~~ The sash shoe of claim ~~27~~¹⁴ wherein the curled convolutions are contained within the shoes, and the companion carrier is attachable to an upper region of a shoe body forming the containment region.

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~~32.~~ A sash balance system for a tilt sash connected on a tilt axis to a pair of counterbalanced lock shoes that move vertically in jamb shoe channels as the sash moves vertically in sash runs, the balance system comprising:

- P1
- a. curled convolutions of a curl spring carried by each of the shoes above the tilt axis to counterbalance the shoes;

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- Pi
Pi
- b. the shoes having surfaces below the curled convolutions arranged for bearing slidably against walls of the shoe channels; and
 - c. the shoes being configured above the bearing surfaces to allow uncurled lengths of the curl springs to pass from the curled convolutions into the shoe channels above the bearing surfaces where the uncurled lengths of the curl springs rest against shoe channel walls during sash movement.

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~~33.~~ The balance system of claim ⁴¹~~32~~ wherein free end regions of the curl springs are fastened in the shoe channels above regions of movement of the shoes.

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~~34.~~ The balance system of claim ⁴¹~~32~~ wherein axes of the curl springs are parallel with a plane of the sash.

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~~35.~~ The balance system of claim ⁴¹~~32~~ wherein each of the shoes carries curled convolutions of a pair of the curl springs arranged to exert a combined lifting force on the sash.

Sub a3
36. A sash shoe comprising:

- a. two identical shoe body parts configured to interconnect;
- b. a sash pin receiver trapped between the interconnected body parts; and
- c. a cam formed on the sash pin receiver and cam follower surfaces formed on the interconnected shoe body parts so that turning the sash pin receiver cams the shoe body parts apart, for locking the shoe in a shoe channel.

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~~37.~~ The sash shoe of claim ³²~~36~~ including a containment region between the interlocked body parts arranged for receiving a curled up length of a curl spring and allowing an uncurled length of the curl spring to extend above the shoe.

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~~38~~. The sash shoe of claim ³²~~37~~ wherein a surface of the containment region bears against an upwardly facing region of the curled length of the spring.

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~~39~~. The sash shoe of claim ³²~~36~~ wherein the pin receiver is accessible from either of a pair of opposite sides of the shoe so that the shoe can operate in either of two orientations relative to a sash.

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~~40~~. The sash shoe of claim ³⁵~~39~~ including a containment region between the interlocked body parts formed with a pair of access openings so that a curled length of a curl spring can be held in the containment region and an uncurled length of the curl spring can extend through either access opening to a region above the shoe.

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~~41~~. The sash shoe of claim ³²~~36~~ wherein shoe body parts include holes that do not align when the shoe body parts are interconnected, and a screw is threaded into one of the holes in one of the shoe body parts to bear against the other shoe body part and adjust a separation of the shoe body parts for adjusting a frictional fit of the shoe body within a shoe channel.

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~~42~~. The sash shoe of claim ³²~~36~~ including a containment region between the interlocked body parts arranged for receiving a curled up length of a curl spring and allowing an uncurled length of the curl spring to extend above the shoe and including a free end region of the uncurled length of the curl spring being connected to a mount that is releasably retained on an upper region of the shoe body until the mount is fastened to a mounting surface.

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~~43~~. The sash shoe of claim ³²~~36~~ wherein the body parts interconnect in one end region and are cammed apart at an opposite end region.

claim 40

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~~44.~~ The sash shoe of claim ³⁹~~43~~ including a containment region adjacent the one end and arranged for receiving a curled up length of a curl spring and allowing an uncurled length of the curl spring to extend above the shoe.

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~~45.~~ A counterbalance system for exerting vertical lift on a pair of sash shoes running in shoe channels to support a tilt sash running in sash runs and connected to the shoes, the system comprising:

- a. the counterbalance force being provided by a curl spring engaging each of the shoes;
- b. free end regions of the curl springs being fastened in the shoe channels above regions of shoe travel;
- c. curled up convolutions of the curl springs being carried by the shoes to exert a lifting force as a function of the curling tendencies of the springs, the friction of spring movement as the shoes move in the shoe channels being limited to the friction involved in curling and uncurling the spring convolutions; and
- d. a connection extending between the shoes and the sash allowing the sash to tilt and be removed from the sash runs while the shoes and the curl springs remain in the shoe channels.

⁵¹
~~46.~~ The system of claim ⁵⁰~~45~~ wherein shoe ends of the connections with the sash are arranged for locking the shoes in the shoe channels when the sash tilts.

⁵²
~~47.~~ The system of claim ⁵⁰~~45~~ wherein axes of the curl springs are parallel with a tilt axis of the sash.

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~~48.~~ The system of claim ⁵⁰~~45~~ including a pair of the curl springs carried by each of the sash shoes.

claim 54

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The system of claim ~~45~~⁵⁰ wherein the curled convolutions are contained within the shoes, and outer ones of the curled convolutions engage surfaces of the shoes to exert the lifting force.

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In a counterbalance system for a tilt sash engaging shoes running in shoe channels and counterbalanced by curl springs, the improvement comprising:

- a. a fixed mount for free end regions of the curl springs in the shoe channels above regions of shoe travel;
- b. uncurled lengths of the curl springs resting within the shoe channels so that the uncurled lengths tending to press against the shoe channels are not moved relative to the shoe channels as the shoes move;
- c. convolutions of the curl springs being curled into containment regions carried by the shoes;
- d. the outermost of the curled convolutions being disposed to bear against surfaces of the containment regions arranged to confront the convolutions aside of the uncurled lengths so that the recurling force of the springs tending to curl the springs into the containment regions exerts lifting forces on the shoes; and
- e. a connection between the shoes and the tilt sash being spaced from the curled convolutions in the containment regions.

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The improvement of claim ~~50~~⁵¹ wherein the connection between the shoes and the sash includes locks that lock the shoes in the shoe channels below the curled convolutions when the sash tilts.

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The improvement of claim ~~50~~⁵² wherein the containment regions are formed within the shoes, and the shoes are wider below than above the containment regions.

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claims 48-49

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~~53.~~ The improvement of claim ~~50~~ wherein each of the shoes carries a plurality of the curl springs.

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~~54.~~ The improvement of claim ~~50~~ wherein the axes of the curled convolutions are parallel with a tilt axis of the sash.

Sub 94

55. A sash shoe comprising:

- a. a shoe body mountable in either of two opposite orientations on either side of a tilt sash;
- b. the shoe body being formed of a pair of identical parts that are interconnected so that either of two opposite faces of the shoe body can be disposed to confront the sash;
- c. a pin receiver trapped between the body parts and having openings on opposite sides so that a sash pin can enter the receiver from either opposite face of the shoe body; and
- d. cam and follower surfaces being arranged between the receiver and the shoe body parts so that turning the receiver in either direction from a neutral position cams apart the shoe body parts to spread apart the opposite faces of the shoe body.

56. The sash shoe of claim 55 wherein the interconnected shoe body parts define a containment region arranged to receive curled convolutions of a curl spring extendable above the shoe body for upwardly biasing the shoe.

57. The sash shoe of claim 56 formed to provide a pair of opposite access openings to the containment region so that curled convolutions of a curl spring can be oriented to extend an uncurled length of the curl spring upward from the shoe through either of the access openings.

58. The sash shoe of claim 56 wherein a free end region of the curl spring is connected to a mount that is releasably retained on an upper region of the shoe.

59. The sash shoe of claim 58 wherein the releasable retention of the mount on the shoe automatically releases when the mount is fastened to a mounting surface.

60. The sash shoe of claim 59 wherein the mount engages a pair of openings in the free end region of the curl spring and engages an undercut projection on the upper region of the shoe.

61. The sash shoe of claim 55 wherein each of the shoe body parts has a screw hole, and a screw is threaded into one of the holes in one of the shoe body parts to engage the other shoe body part for adjustably separating the shoe body parts.

62. The sash shoe of claim 55 wherein the body parts interconnect in one end region and are spread apart in an opposite end region.

63. The sash shoe of claim 62 wherein the interconnected shoe body parts define a containment region proximate to the one end and arranged to receive curled convolutions of a curl spring extendable above the shoe body for upwardly biasing the shoe.

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